NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

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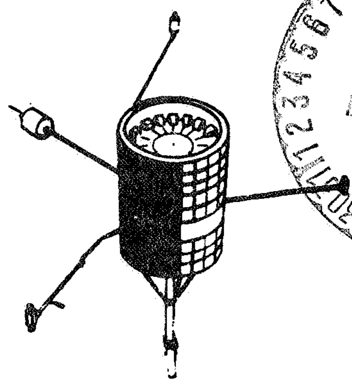
FOR RELEASE: SUNDAY
November 3, 1968

RELEASE NO: 68-192



PRESS KIT

PROJECT: PIONEER D

(To be launched no earlier than Nov. 6)

contents

10/30/68

NEWS

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PIONEER D LAUNCH

The United States will launch Pioneer D, the fourth in the current series of Pioneer interplanetary spacecraft, from Cape Kennedy, Fla., no earlier than Nov. 6, 1968.

Pioneer D's mission is to acquire additional data on solar plasma and energetic particles and magnetic fields propagated by the Sun towards the Earth. These data, combined with that from previously launched Pioneer spacecraft still operating, will be used in the continuing study to understand solar processes, the interplanetary medium, and effects of solar activity on the Earth's environment.

The launch window for Pioneer D is from 4:45 to 4:59 a.m. EST. The window opens slightly earlier on the succeeding days.

-more-

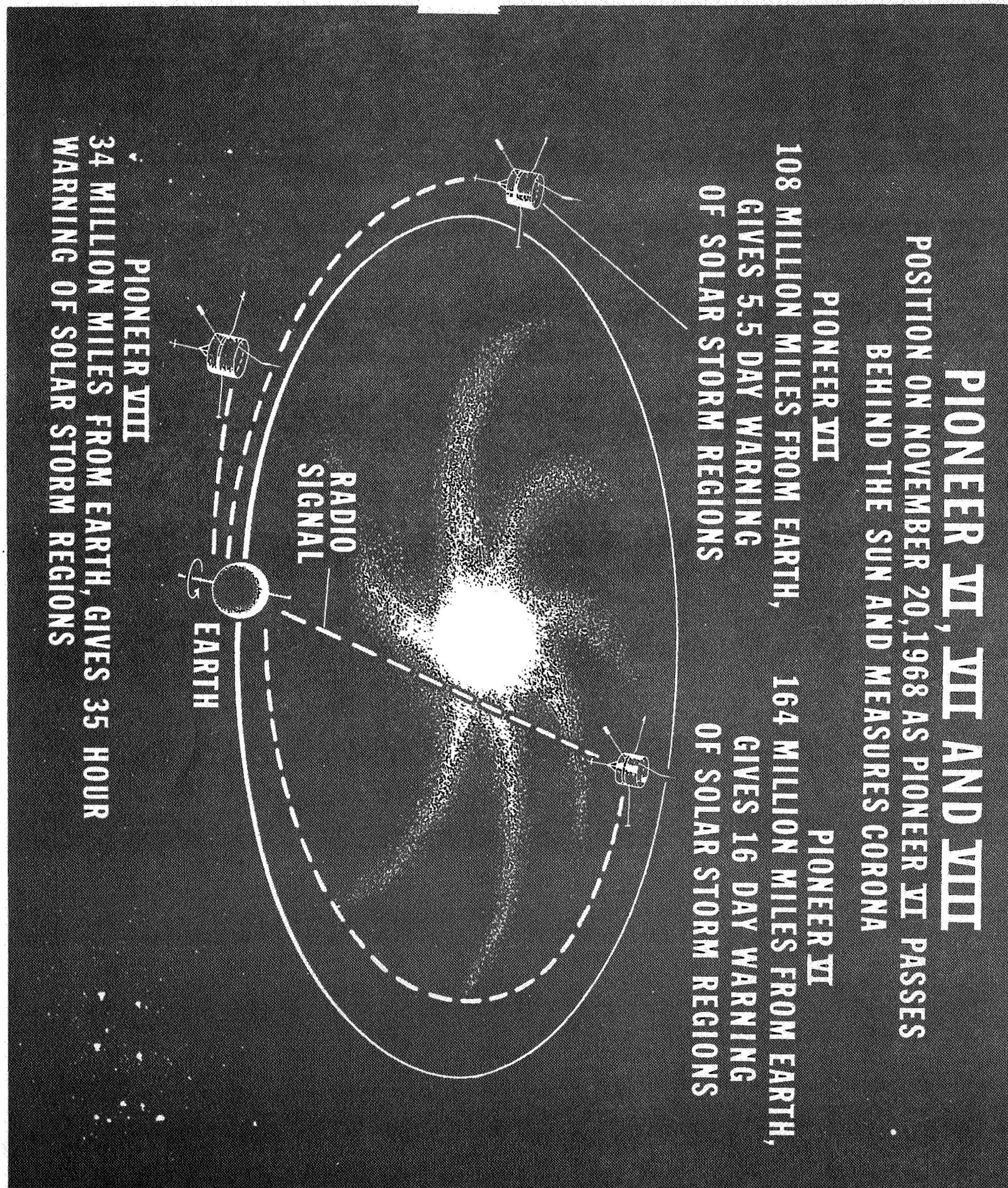
Pioneer D will join three other Pioneers spotted around the Sun and will become Pioneer IX when it achieves successful orbit. Pioneers are the only currently active U. S. interplanetary craft.

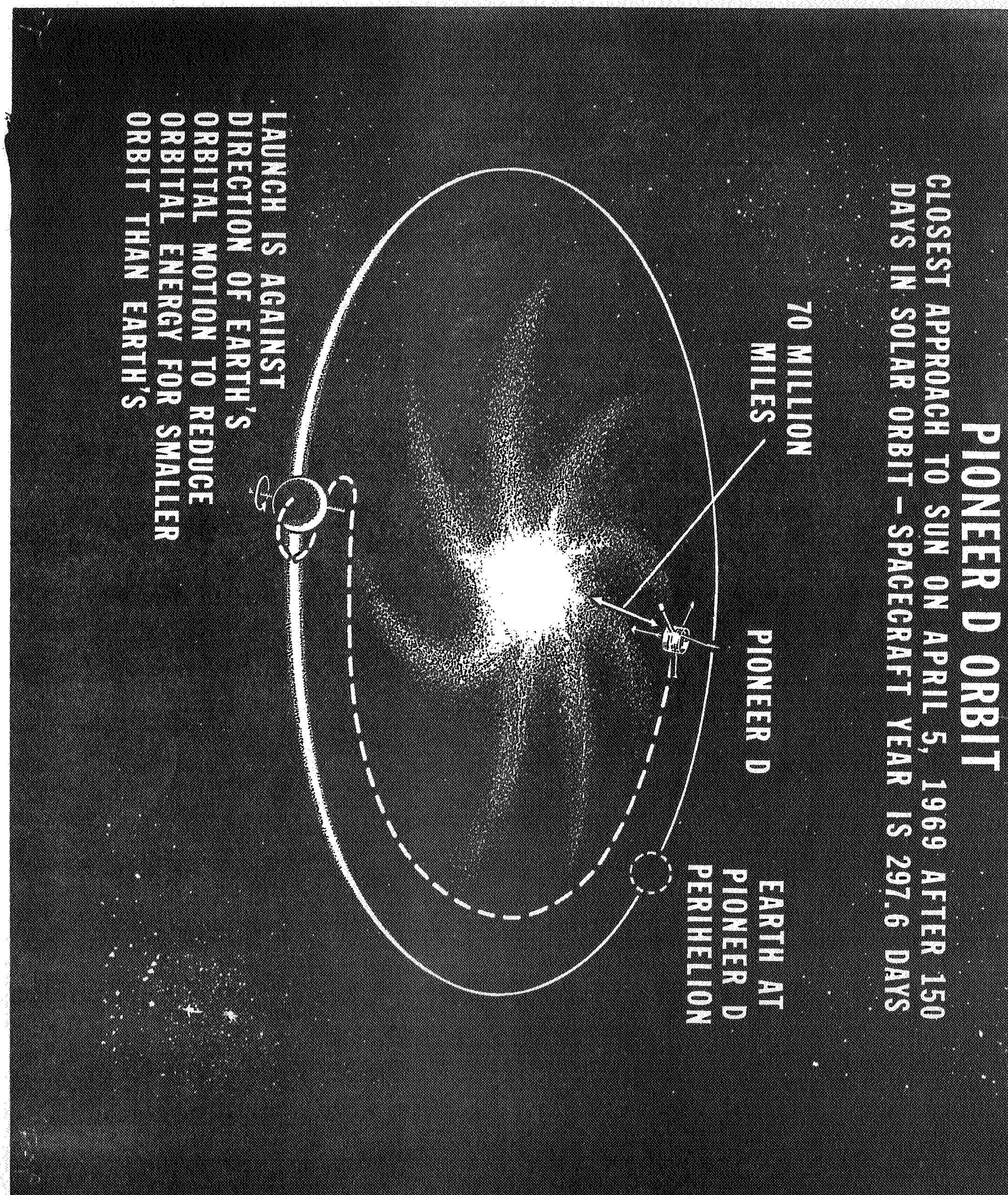
Launch dates and distances of earlier Pioneers are: Pioneer VI, launched Dec. 16, 1965, now 164 million miles from Earth; Pioneer VII, Aug. 17, 1966, now 108 million miles away; Pioneer VIII, Dec. 13, 1967, 34 million miles away. Through Nov. 1, 1968, the three Pioneers had received 20,000 commands and returned six billion bits of data on 6,500 miles of data tape.

After launch, Pioneer D will shuttle 23 million miles in and out from the Sun in its orbital path every five months as the solar cycle peaks in 1969. Travelling closer to the Sun than earlier Pioneers -- to within 70 million miles of the Sun -- it will observe solar particle concentrations almost double those found near Earth.

About 770 days after launch, Pioneer D will pass directly behind the Sun.

During the following 100 days, the spacecraft may pass behind the Sun two more times. These three separate passes would allow the most extensive measurements of the solar corona yet made -- by analysis of the way passage through the corona affects the three Pioneer radio signals.


PIONEER VI, VII AND VIII
POSITION ON NOVEMBER 20,1968 AS PIONEER VI PASSES
BEHIND THE SUN AND MEASURES CORONA
PIONEER VII
108 MILLION MILES FROM EARTH,
GIVES 5.5 DAY WARNING
OF SOLAR STORM REGIONS
PIONEER VI
164 MILLION MILES FROM EARTH,
GIVES 16 DAY WARNING
OF SOLAR STORM REGIONS
RADIO
SIGNAL
EARTH
PIONEER VIII
34 MILLION MILES FROM EARTH, GIVES 35 HOUR
WARNING OF SOLAR STORM REGIONS


PIONEER D ORBIT
CLOSEST APPROACH TO SUN ON APRIL 5, 1969 AFTER 150
DAYS IN SOLAR ORBIT – SPACECRAFT YEAR IS 297.6 DAYS
70 MILLION
MILES
PIONEER D
EARTH AT
PIONEER D
PERIHELION
LAUNCH IS AGAINST
DIRECTION OF EARTH'S
ORBITAL MOTION TO REDUCE
ORBITAL ENERGY FOR SMALLER
ORBIT THAN EARTH'S

This triple occultation will require a launch speed which can vary only a few miles-per-hour in some 24,000 mph. Whether triple occultation can occur will not be known until precise launch speed is determined after launch.

If it does occur, the spacecraft, on the other side of the Sun from the Earth, will appear to an Earth observer to pass behind the Sun, then slow down and speed up again, passing behind the Sun twice more.

This can happen because Pioneer D on a smaller, oval orbit travels faster than the Earth on most of its orbit, but slows down below the Earth's orbital speed at its farthest point from the Sun.

The eight scientific experiments on Pioneer D include a new, improved magnetometer, and instruments to measure the solar wind, cosmic ray particles, electron density, electric fields and cosmic dust.

In a new celestial mechanics experiment, tracking data from all of the Pioneers will be used to refine measurements of the Earth-Moon mass ratio, Sun-Earth distance, planet orbits, and to check the theory of general relativity.

The Cosmic Ray Telescope on Pioneer D is similar to that on Pioneer VIII which made the first measurements of fluorine among galactic cosmic ray particles. It has measured nuclei of the 14 lightest elements in a variety of energy ranges. These include hydrogen nuclei travelling at 90 per cent of light speed.

The Electric Field experiment on Pioneer D is also similar to that flown on Pioneer VIII, which found very large waves in the solar wind.

The million-mile-an-hour solar wind, which constantly blows out from the Sun, is threaded with curving magnetic filaments rooted in the Sun, carrying massive streams of high energy particles. At the Earth, they have an average diameter of about two million miles. New ones constantly sweep past the Earth in co-rotation with the Sun's 27-day rotation. Very-high-energy solar storm particles reach the Earth by a more direct path.

The Pioneers can measure this solar wind, particles and fields far more precisely than past spacecraft. The 145-pound craft are "spinners." They continuously scan a full circle in the plane of the Earth's orbit.

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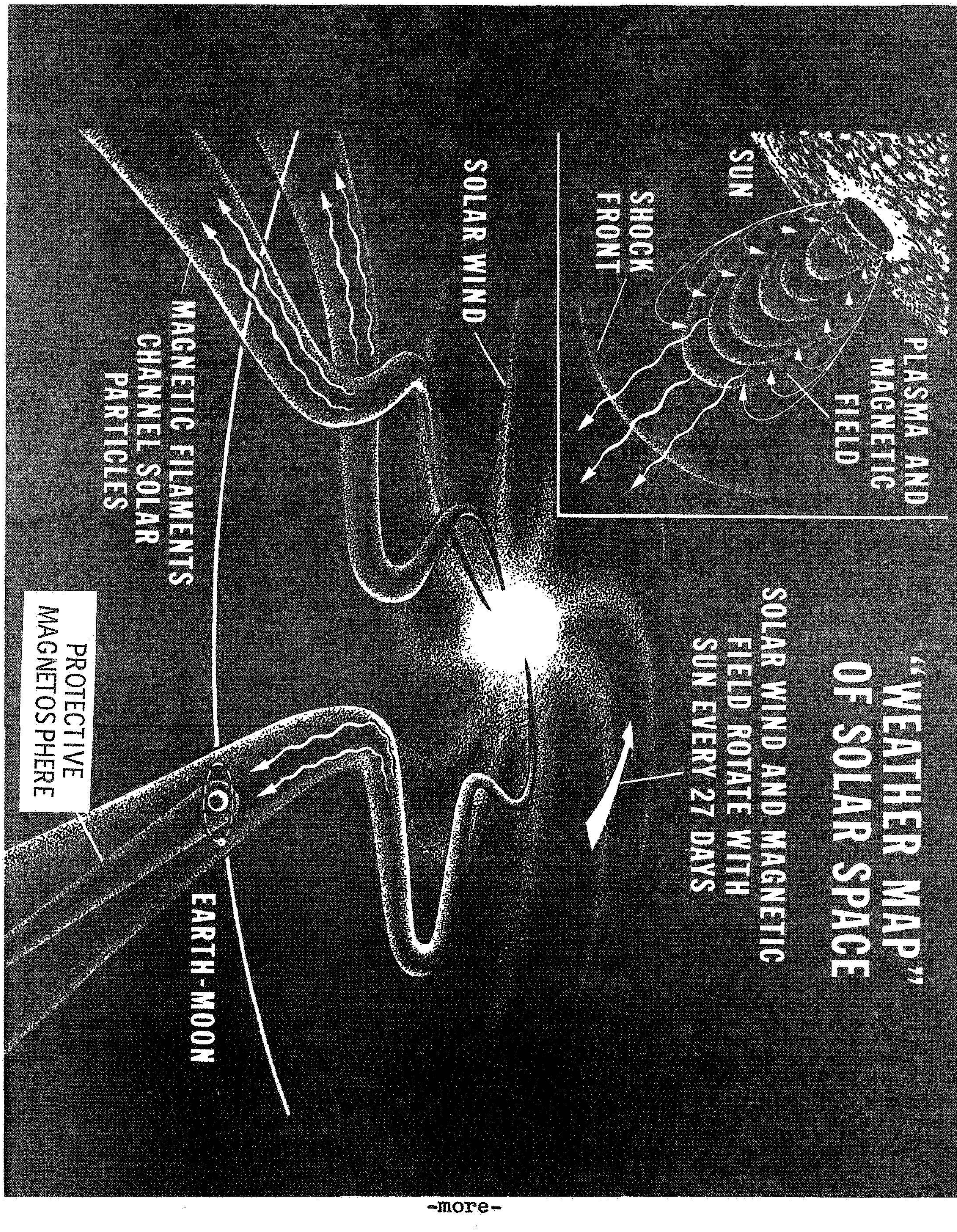
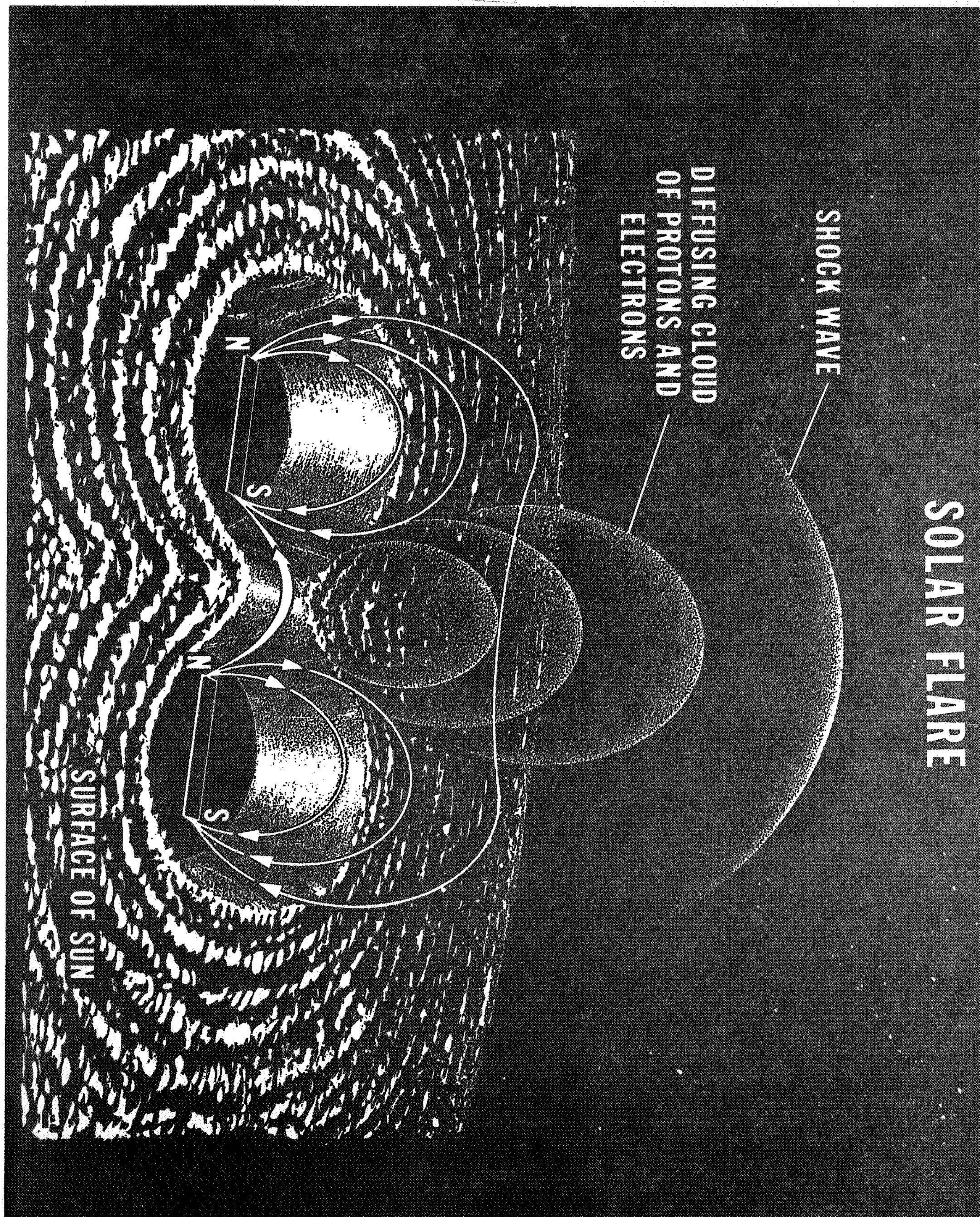

"WEATHER MAP" OF SOLAR SPACE
SOLAR WIND AND MAGNETIC FIELD ROTATE WITH SUN EVERY 27 DAYS
PLASMA AND MAGNETIC FIELD
SUN
SHOCK FRONT
SOLAR WIND
MAGNETIC FILAMENTS CHANNEL SOLAR PARTICLES
PROTECTIVE MAGNETOSPHERE
EARTH-MOON


SOLAR FLARE
SHOCK WAVE
DIFFUSING CLOUD OF PROTONS AND ELECTRONS
N
S
N
S
SURFACE OF SUN

The Environmental Sciences Service Administration (ESSA) uses Pioneer Space Weather Reports daily in its analyses of solar weather at its Space Disturbance Laboratory in Boulder, Colo.

Pioneer D will carry for the first time an improved data system with the addition of a "convolutional coder," which is expected to double the data returned during most of the mission through a new way of processing the data signal on the spacecraft. The system eliminates almost all transmission errors, and can apply to most digital data communications in space or on Earth.

In addition to Pioneer D, the Delta launch vehicle will carry a 40-pound Test and Training Satellite, TETR-2, into a separate elliptical 200 by 500 mile orbit, inclined 32 to 35 degrees to the Equator. The piggy-back payload is mounted in the rear of the second stage and is ejected into a 98-minute orbit at 21 minutes into the mission.

TETR-2 will provide NASA's Office of Tracking and Data Acquisition with an orbiting target for checking out equipment and training personnel of its Manned Space Flight Network, MSFN, under conditions similar to those provided by an orbiting Apollo spacecraft.

TETR-1, launched along with Pioneer VIII, carried out a similar mission with complete success.

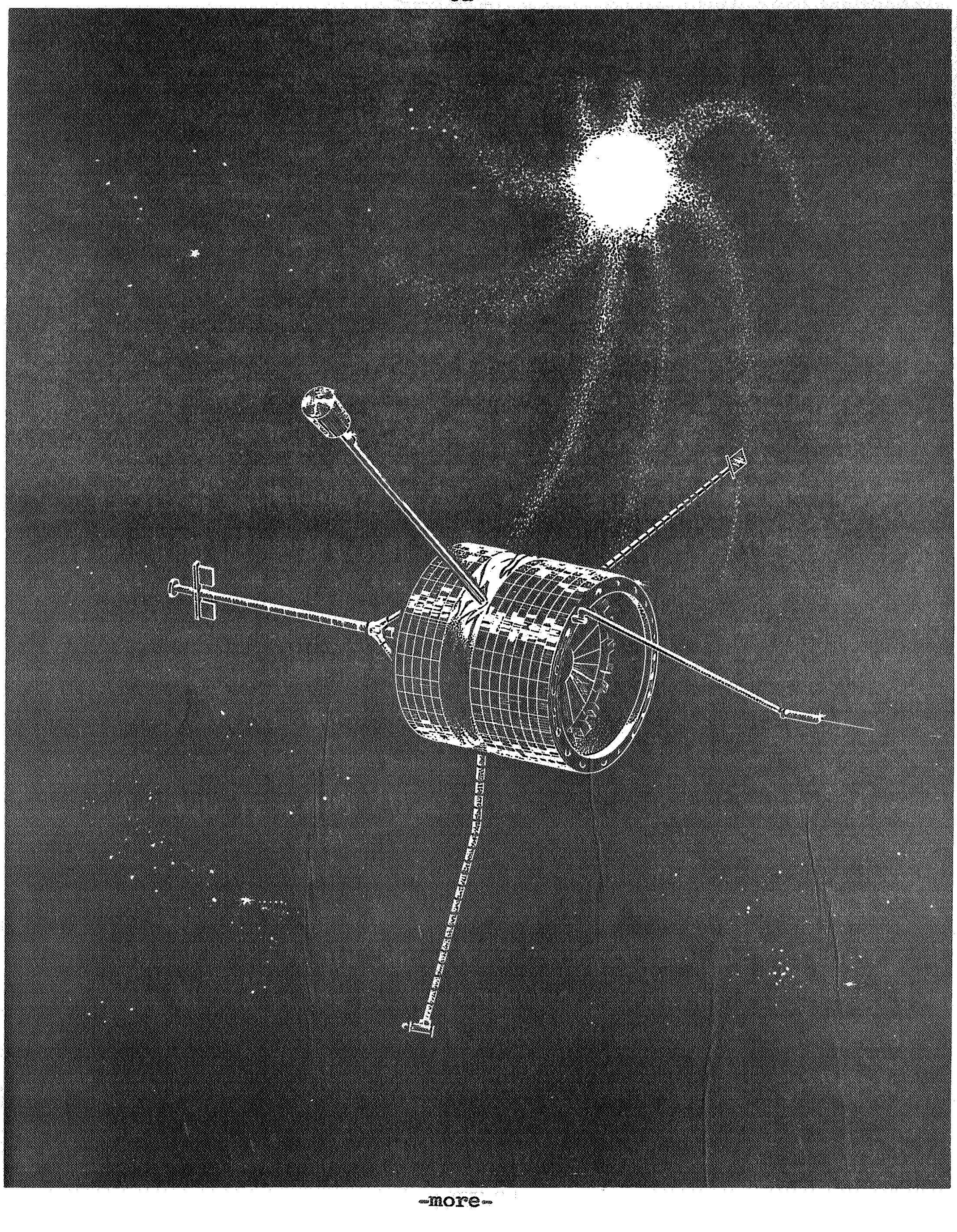
TETR-1 was launched December 13, 1967, and reentered the Earth's atmosphere over the Pacific Ocean April 28 after being successfully utilized in test and training exercises of the MSFN prior to the network's successful support role in the Apollo 5 and 6 flights.

The Pioneer program is directed by NASA's Office of Space Science and Applications. Project management is by NASA's Ames Research Center, Mountain View, Calif. The Delta launch vehicle is managed by Goddard Space Flight Center, Greenbelt, Md., and is launched by Kennedy Space Center, Fla.

Communications and tracking will be by NASA's Deep Space Network (DSN), operated by the Jet Propulsion Laboratory, Pasadena, Calif.

The Pioneer spacecraft are built by TRW Systems Group, Redondo Beach, Calif. The Delta rocket is built by McDonnell Douglas Corp. at Santa Monica, Calif.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS)



PIONEER D SPACECRAFT

Overall Configuration

The Pioneers are designed as rugged, high-performance spacecraft, able to return large amounts of data on flights of several years over distances of many millions of miles.

All spacecraft systems have been chosen for simplicity and reliability. Maneuvering, for example, is handled by a single cold-gas jet.

Pioneer D weighs 148 pounds and carries 39.5 pounds of scientific experiments. Attitude of the Pioneers is extremely stable. Average drift for each six months in space has been about one degree.

The spacecraft is a drum-shaped container, 35 inches high and 37 inches in diameter. Its sides are covered with solar cells, and divided by a narrow circular band containing apertures for four experiments and four orientation Sun sensors. A fifth Sun sensor provides the experiments with a directional reference to the Sun's position.

At 120-degree intervals around the sides of the spacecraft are three five-foot four-inch booms, deployed horizontally in flight by the spin of the spacecraft.

Within the spacecraft, a circular platform carries most of the equipment. Below the platform is a pressure sphere with gas for the orientation system.

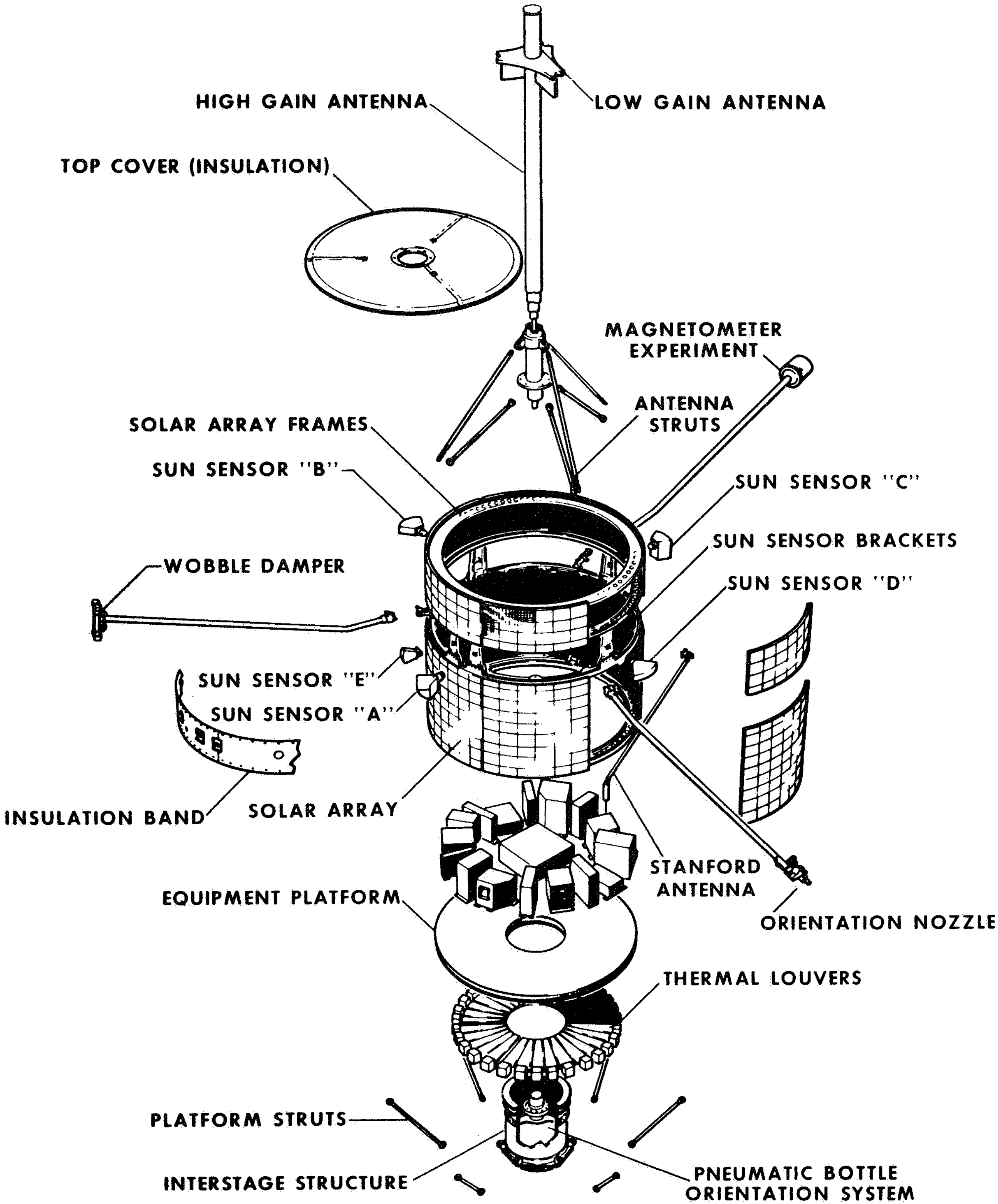
The spacecraft structure, made principally of aluminum, is lightweight and its cylindrical shape is inherently strong. There are more than 56,000 parts in Pioneer, including its scientific instruments.

Communication System

The 35-pound Pioneer communications, timing, and data handling system has performed well aboard Pioneers VI, VII, and VIII. It has returned 6 billion data bits to Earth of 3,400 measurements. Pioneers VI, VII, and VIII have received 20,000 commands from the ground.

It maintains two-way S-band communication at about 2,300 megahertz.

PIONEER D SPACECRAFT COMPONENTS



Commands are sent to Pioneer from DSN antennas in binary (1,0) code. These commands are received by spacecraft antennas and routed to one of two radio receivers. They then go to one of two command decoders. Once decoded, commands are routed by the command distribution unit to a spacecraft system or experiment for execution.

To send information back to Earth, the spacecraft transmitter driver puts coded data on the basic S-band carrier and routes it to one of the two spacecraft travelling wave tubes, which amplifies the signal to about eight watts.

The Pioneers have the greatest data-return capacity of any interplanetary spacecraft because they match the most efficient rate of data return with the distance from the Earth. They return data at 512, 256, 64, and 8 bits per second.

The new convolutional coding system should double the data rate, almost doubling the amount of data returned. If the new system fails to operate properly, controllers can switch back to the standard system.

With the new coding system, an encoder uses the signals furnished to each on-board sensor to provide proper synchronization with the spacecraft digital telemetry unit. Data from this unit is processed by an on-board data system into a coded data bit stream for transmission to the ground.

The ground station computers are programmed to process the coded data bit stream by essentially reversing the spacecraft coding system process. The final data output has such a low error rate that the total information rate is about double that of the earlier system.

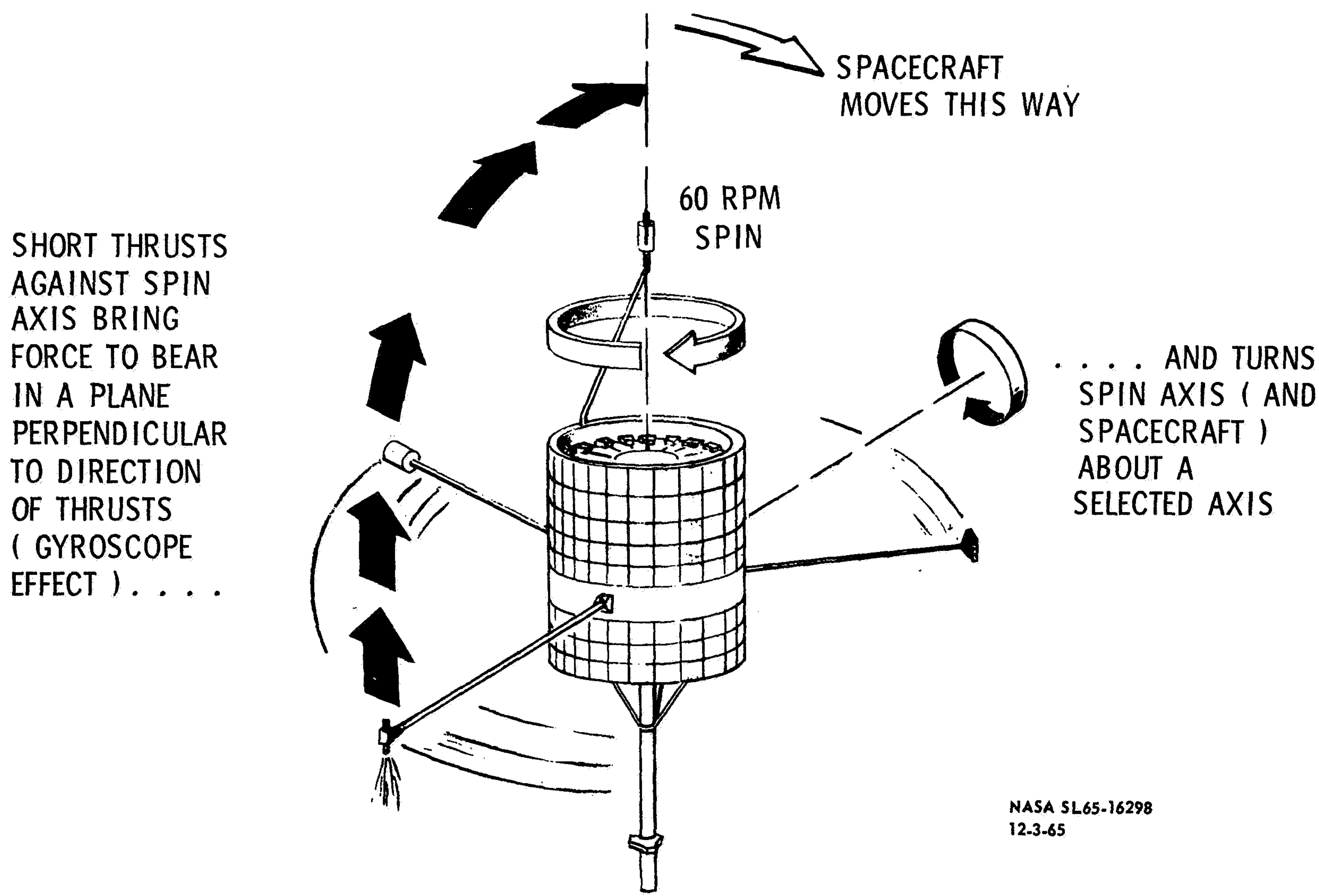
The spacecraft memory can store samples of data for up to 19 hours.

Attitude Control

The Pioneers use the gyroscopic effects of their 60-rpm rotation to maintain a stable attitude.

Changes in attitude are achieved by turning the spacecraft about a selected axis through many brief thrusts from the nitrogen gas jet at the end of one boom. Force from this gas jet must be applied perpendicular to the desired direction of motion because the spinning craft precesses like a gyroscope.

PIONEER ORIENTATION MANEUVERING



Thrusts applied at one point on the circle of spacecraft rotation are timed by a sensor which sees the Sun once each spacecraft revolution.

The many thrusts at one point produce wobbling rotation. Wobble is eliminated by flexibility of all three booms and by a damper consisting of two small balls in two cylinders at the end of one boom.

Pioneer D must have its spin axis perpendicular to both Sun-spacecraft line and Earth-spacecraft line, so that solar cells are illuminated efficiently, and the narrow beam antenna focuses on the Earth.

Sun orientation is automatic. One Sun-sensor sees the Sun for 80 degrees above the plane of spacecraft rotation; a second sees the Sun for 80 degrees below this plane. Proper orientation is achieved when the spacecraft turns until both see the Sun.

For Earth orientation, ground commands rotate the spacecraft around the spacecraft-Sun line, until its high-gain antenna acquires the Earth.

Power Systems

Pioneer D's 10,368 silicon crystal, n-on-p solar cells provide the spacecraft its 60-watt power needs.

Auxiliary power during launch, before solar cells begin to function, is provided by a rechargeable silver-zinc battery with a capacity of about two hours.

Temperature Control

Temperature is controlled by managing heat produced by spacecraft equipment and by heat-reflective coatings on the spacecraft exterior. Twenty louvers under the spacecraft equipment platform, actuated by bi-metallic springs, open and close automatically to release heat.

Magnetic Field

The magnetic field of the Pioneers is extremely low, 1/10 gamma (1/500,000 the Earth's field). Engineers achieved this low magnetism by using non-magnetic materials, new fabrication and inspection techniques, and design innovations.

SCIENTIFIC INVESTIGATIONS

Interplanetary space is hundreds of times less dense than the most extreme vacuums on Earth. Nevertheless, solar and galactic events propagate through it. They cause the auroras, feed the Van Allen radiation belts, and provide the Earth its basic energy source.

Known phenomena in interplanetary space include:

Particles -- Electrons and hydrogen, helium and other nuclei carrying an electric charge which make up the "solar wind"; cosmic rays from Sun or galaxy which are extremely energetic (fast-moving) charged nuclei of many elements; cosmic dust and meteoroids.

Radiation -- The entire electromagnetic spectrum such as light, radio and X-rays.

Fields -- Magnetic, electric and gravitational.

Scientists now believe, based to a substantial degree on Pioneer discoveries that, these ingredients go together as follows:

Description of Solar Space

The solar wind originates when the solar surface heated by the thermonuclear reaction in the Sun's center, throws off an ionized gas into space. Politive nuclei and negative electrons are ejected into space from the Sun's 2,000,000 degree F. corona, perhaps heated by local shock waves. The particles reach a speed of around one million miles-per-hour as solar gravity weakens.

The magnetic field on the Sun's surface is the total result of a mass of small bi-polar fields. This complex twisted field is carried by the solar wind far beyond the Earth's orbit. The field is further bent as numerous solar wind "beams" (masses of gas on separate paths) collide and change direction.

In the Sun's corona, the magnetic field divides into major radial sectors (commonly from two to seven), each with a single field direction the reverse of its neighbor.

These large sectors, extending far beyond the Earth, are believed to be created by surface regions which send out high-speed streams of solar wind for months. When a region dies, its sector disappears, and new regions produce new sectors.

Local storms on the Sun throw out dense masses of solar wind particles and of high energy particles (solar cosmic rays). During storms, magnetic field strength rises from 100 to 1,000 times the normal of 100,000 gamma. (Earth's surface field is 50,000 gamma; interplanetary field, five gamma).

Lower energy solar cosmic ray particles cover the 93 million miles to the Earth in one to two hours. Higher energy particles arrive in as little as 20 minutes. They break out of the twisted interplanetary field but follow its general direction. They travel in long curves arriving at the Earth-Sun line at an angle of about 45 degrees.

The flow of lower energy cosmic rays often lasts many hours. The Sun appears to "store" them near its surface. The particles frequently are injected onto a number of different magnetic filaments, and particles from the same solar storm may reach the Earth in entirely separate, twisted streams.

The solar wind spiraling out from high speed regions on the Sun collides with slower solar wind masses, creating relatively dense shock areas. These radial shock fronts behave like vanes of a centrifugal pump, pushing galactic cosmic rays out of the inner solar system.

Very intense waves, much like sound waves, form during solar storms, especially at boundaries between fast and slow-moving segments of the solar wind. These waves accelerate and alter solar wind flow.

The solar wind now is believed to blow out to between 900 million and nine billion miles. Where it stops is the end of the interplanetary field and the boundary between interplanetary and interstellar space. Slight variations in direction of galactic cosmic ray particles may be due to passage through this boundary.

The North-South magnetic field of the Sun is the sum of many local fields. It seems to disappear at the peak of each 11-year solar cycle and then reappear with North and South poles reversed.

PIONEER D
SCIENTIFIC INSTRUMENTS AND
ASSOCIATED INVESTIGATIONS

Instrument	WT (lb.)	Power (watts)	Investigators
Three-Axis Magnetometer	6.66	5.2	C.P. Sonnett* D.S. Colburn Ames Res. Cent.
Cosmic-Ray Telescope	7.89	2.74	W.R. Webber* Univ. of Minn.
Radio Propagation Detector	5.05	1.35	V.R. Eshleman* A.M. Peterson Stanford Univ. R.L. Leadabrand H.T. Howard R. Long Stan. Res. Inst.
Electric Field Detector	0.80	0.43	F.L. Scarf* G.M. Cook I. Green TRW Systems
Quadrispherical Plasma Analyzer	5.91	3.10	J.H. Wolfe* D.D. McKibbin Ames Res. Cent.
Cosmic-Ray Anisotropy Detector	5.56	1.78	K.G. McCraken* Univ. of Adelaide, Australia W.C. Bartley Nat. Acad. of Sci. R.T. Bukata S.W. Cent. of Adv. Studies U.R. Rao Res. Lab., India
Cosmic Dust Detector	4.26	0.41	O.E. Berg* GSFC
Celestial Mechanics	--	--	J.D. Anderson* JPL

* Principal Investigators

EXPERIMENTS

A summary of the scientific experiments with essential characteristics of the instruments and the experimenters is given in the table.

Three-Axis Magnetometer

This experiment continuously measures the rapidly-varying strength and direction of the interplanetary magnetic field in three axes simultaneously.

The experiment sensor is mounted on a five-foot boom to isolate it from the spacecraft's tiny magnetic field.

It measures the field over a range of -200 to +200 gamma with a resolution of .4 gamma. It contains three mutually perpendicular fluxgate sensors. A thermal-electric motor rotates two of the sensors 90 degrees on command, interchanging them to measure sensor drift due to gradual build-up of the spacecraft field. The instrument's precision is due in part to a digital signal processor, which eliminates effects of spacecraft spin, and to digital filters, which process the three field components to eliminate sampling errors.

Quadrispherical Plasma Analyzer

This experiment measures particles in the solar wind -- quantities, directions, energies, and temperatures.

The instrument employs two parallel curved plates. A voltage across the plates is varied to select particles to be measured. Particles then pass between the plates and land on a collector. Horizontal directions are measured by noting the direction the probe looks out from the spinning spacecraft; vertical direction by three collector plates which look out over an arc of 160 degrees. The experiment measures electron energies from 14 to 1000 electron volts, and positive ions from 200 to 15,000 electron volts. It can measure 50,000 to 100 million particles per sq. cm per second with accuracies better than 1 degree in direction and 1 per cent in velocity.

Radio Propagation Detector

This experiment determines total electron content between Pioneer and the Earth. The 150-foot dish antenna at Stanford University sends radio signals to a special receiver on the spacecraft.

The receiver can hear the Stanford signal from 280 million miles. This will allow solar corona studies when Pioneer D moves behind the Sun in about two years. Experimenters send low and high frequency signals to the spacecraft. The greater slowing of the low frequencies by electrons in space allows measurements of electron density.

Electric Field Detector

This instrument measures the electric components of low frequency radio waves and waves created by density variations in the solar wind. Unequal concentrations of positive ions and negative electrons have electric fields between them. The instrument uses an alternating current electrometer to measure the fields as shown by small voltage changes in the Stanford antenna on the spacecraft.

Cosmic Ray Anisotropy Detector

This instrument finds arrival direction, mass, and energy (speed) of solar and galactic cosmic ray particles.

It consists of a crystal scintillator which produces flashes of light of varying intensity, depending on the energy, direction and type of cosmic ray particle which strikes its crystal lattice. The instrument detects particles arriving from eight directions in the plane of the Earth's orbit, and from below and above the spacecraft. The energy range measured is from three million to 360 million electron volts.

Cosmic Ray Telescope

This instrument measures numbers, energy, direction, charge, and distribution through space of nuclei of atoms from one million to one billion electron volts. It employs two solid-state, surface-barrier detectors, three solid-state lithium-drift detectors, one detector with a synthetic sapphire window to a photomultiplier tube, and one with a plastic guard cup monitored by photomultipliers.

Selection of one of five detector combinations to be monitored is by ground command. Resolution is better than any such instrument to date. By finding the relative abundance of elements in cosmic rays, scientists can develop a theory of their origin.

Cosmic Dust Detector

The instrument measures the momentum, energy, and distribution in interplanetary space of minute meteoroids. It determines the velocity, mass, and flux of particles from 50 millionths to less than a trillionth gram at speeds up to 900,000 mph.

Two sets of thin-film panels front a piezoelectric crystal microphone mounted on an impact plate. These elements measure particles of light time between front and rear films, determine direction by comparing front and rear penetration points, and measure impact on the plate.

Celestial Mechanics Experiment

The purpose of this experiment is to better determine: the Earth-Moon mass ratio, the Astronomical Unit (Earth-Sun distance), shape and orientation of the planet orbits, and to test general relativity. Pioneer data is useful for this because of: its long duration; solar orbits; spin stabilization with negligible non-gravity effects; and different orbits for each Pioneer.

The experiment will use the DSN tracking data and large digital computers.

THRUST-AUGMENTED IMPROVED DELTA LAUNCH VEHICLE

The launch vehicle for Pioneer D is the outstandingly successful workhorse Delta. This will be the 60th Delta flight. If successful, Pioneer D will be the 56th spacecraft successfully launched by the Delta vehicle.

Delta is 92 feet high (including shroud). It has a maximum diameter of eight feet without strap-on solid rockets. Its liftoff weight is about 75 tons, and liftoff thrust is 333,550 pounds.

Engines for the kerosene-liquid oxygen fueled first stage are built by the Rocketdyne Division, North American Rockwell Corp. The three solid rockets which strap on the first stage are by Thiokol Chemical Corp. The UDMH-IRFNA fueled liquid engines of the second stage are by Aerojet-General Corp. Major autopilot contractors for Honeywell, Inc. are Texas Instruments, Inc., and Electro-Solids Corp. Guidance contractor is Western Electric Co. Delta's third stage solid engine is by United Technology Center.

TEST AND TRAINING SATELLITE (TETR-2)

The Delta payload will include a small, 40-pound Test and Training Satellite (TETR-2), which houses a transponder to transmit and receive the S-band data signal simulating the Apollo spacecraft. TETR-2 will be used in the S-band system checkout and training exercises with the Manned Space Flight Network.

TETR-2 is a follow-on to TETR-1 which was highly successful in carrying out its mission of testing the Apollo communications network.

TETR-2 will be piggy-back launched from the Delta vehicle. It is mounted in the rear of the second stage, with a timer set to eject TETR-2 rearward at three feet per second, approximately one minute after the third stage of the Delta has ignited. The planned orbit for TETR-2 is elliptical at an inclination of 32 to 35 degrees with perigee of 200 miles and apogee of 500 miles.

The spacecraft is octahedron-shaped (bottom-to-bottom pyramids), 11 inches on each side.

The top apex supports an S-band antenna with mast. At two opposite apexes in the center plane are mounted the VHF transmitter antenna sections. A fitting is at the bottom for mounting and ejecting the spacecraft from its launch canister. The VHF command telemetry antenna section is located near the bottom apex.

The electrical power is generated through solar cells mounted on each of the eight surface panels of the spacecraft. This power will be used to re-charge the batteries which furnish power requirements when TETR-2 is operating.

The batteries are designed to provide approximately three hours of continuous S-band transponder operations. After maximum operating time, a period of about 20 hours is required to recharge the batteries.

LAUNCH WINDOW AND FLIGHT EVENTS

Launch windows during November for the Pioneer D mission exist from Nov. 6 to 22. The once-each-day periods are of about 15 minutes duration.

Delta No. 60 will be launched from Complex 17, Pad B on a launch azimuth of 108 degrees.

The strap-on Delta rockets burn out at 14.4 nautical miles high and 10.6 miles downrange at a speed of 2,148 mph. First stage burnout comes at 2.5 minutes after launch, 55.9 nautical miles altitude and 92.4 miles downrange at a velocity of 8,940 mph.

At two minutes and 50 seconds after launch, the fairing covering the spacecraft is jettisoned, and at eight minutes and 55 seconds 1,100 miles downrange and 203 miles above the Earth, second stage engines burnout at a speed of 16,600 mph.

Third stage burnout occurs at 20 minutes, 47 seconds after launch, 3,794 miles downrange at 250 miles altitude. The spacecraft is then traveling at 23,784 mph and is on interplanetary trajectory.

Pioneer D's planned perihelion (closest distance to the Sun) is 70 million miles, and aphelion (farthest from Sun) is 93 million miles.

Delta will place Pioneer D into a smaller solar orbit than the Earth's orbit, and the spacecraft will move steadily ahead of the Earth due to its larger orbital velocity.

Two seconds after third-stage separation, spacecraft booms will deploy automatically, and the spacecraft will automatically orient perpendicular to the Sun for solar cell operation. Without solar cell power, batteries would fail after about two hours.

The high-power amplifier for the spacecraft transmitter turns on immediately after third-stage separation, sending out a wide beam signal via the spacecraft's low-gain antenna.

About 30 minutes after liftoff, the tracking station at Johannesburg, South Africa, acquires the spacecraft. A key task is to check solar cell electric power output. During the first six hours, the seven scientific experiments will be turned on, one at a time.

At about 14 hours after launch, experimenters will send radio signals from Stanford's 150-foot dish antenna to the Stanford radio receiver aboard the spacecraft. Data will return to Goldstone, thence to Stanford. This process continues throughout the mission.

During the first two days after launch, controllers at Goldstone will command the spacecraft to change position until its high-gain antenna points precisely at the Earth to maintain a strong, two-way signal for the life of the mission.

With the DSN's 85-foot antenna, controllers will reduce the data transmission rate from 512 bits per second (bps) to 256 bps about 79 days after launch; from 256 bps to 64 bps about 96 days after launch; and from 64 bps to 16 bps about 126 days after launch. The communications limit with the 85-foot antenna will be reached about 156 days after launch with Pioneer D about 52 million miles from Earth. Without the convolutional coder, the transmission limit for each data rate would be reached 16 to 20 days earlier. After reaching the limit of the 85-foot antenna, tracking will shift to the 210-foot antenna at Goldstone, which will allow a data rate of 64 bps. Tracking by this station, however, will have to be shared with other deep space missions.

THE DEEP SPACE NETWORK

Three 85-foot antennas of NASA's Deep Space Network (DSN), located at 120-degree intervals around the Earth, will track Pioneer D for the first 50 to 60 million miles.

The DSN's 210-foot antenna at Goldstone, Calif., will receive data from Pioneer D as well as VI, VII, and VIII, all the way around the Sun (maximum distance about 200 million miles). The sensitivity of this antenna and its components is one tenth of one trillionth of a trillionth watt. This means the life of the Pioneers is as long as their radio and other systems last.

The DSN is under technical direction of the Jet Propulsion Laboratory, Pasadena, Calif.

Four DSN stations will be used for Pioneer D, Echo and Mars stations at Goldstone; Canberra, Australia; and Madrid, Spain. The station at Johannesburg, South Africa, will track during the first few days of the mission.

For Pioneer, the DSN stations have been equipped with special command encoders and other equipment.

The DSN tracks the spacecraft by means of two-way Doppler. A signal is sent from the antennas at a precisely known frequency, and a transponder aboard the spacecraft returns it at a frequency increased by an exact ratio. Motion of the spacecraft away from Earth causes both frequencies to shift slightly downward. These frequency shifts can be used to calculate the velocity within a few feet per second (despite distances of millions of miles) plus exact orbit and distance from Earth.

Quick-look information is transmitted from DSN stations to the DSN Space Flight Operations Facility (SFOF) at JPL.

Within a few days after launch, command activities will shift to Ames Research Center.

The complete tape of recorded data received at each DSN station is mailed to the SFOF for checking and then sent to Ames. There it is processed into separate tapes and distributed to experimenters, contractors and project personnel.

PIONEER PROJECT OFFICIALS

NASA Headquarters

Dr. John Naugle, Associate Administrator for Space Science and Applications
Donald P. Hearth, Director, Planetary Programs
Glenn A. Reiff, Pioneer Program Manager
Clarence P. Wilson, Pioneer Program Engineer
Dr. Albert G. Opp, Pioneer Program Scientist
Isaac T. Gilliam, Delta Program Manager

Ames Research Center

H. Julian Allen, Director
John V. Foster, Director of Development (Acting)
Charles F. Hall, Pioneer Project Manager
Dr. John H. Wolfe, Pioneer Project Scientist
Ralph W. Holtzclaw, Pioneer Spacecraft Systems Manager
Joseph E. Lepetich, Pioneer Experiments Systems Manager
Robert R. Nunamaker, Pioneer Flight Operations Manager
Myles D. Erickson, Pioneer Data Handling Manager
Robert U. Hofstetter, Pioneer Launch Vehicle and Trajectory Analysis Manager

Kennedy Space Center

Dr. Kurt Debus, Director
Robert H. Gray, Assistant Director for Unmanned Launch Operations
Hugh A. Weston, Jr., Chief, Delta Operations

Goddard Space Flight Center

William B. Schindler, Delta Project Manager

Jet Propulsion Laboratory

Dr. Nicholas A. Renzetti, Pioneer Tracking and Data Acquisition Systems Manager
Alfred J. Siegmeth, Pioneer DSN Manager

TRW Systems Group

Bernard J. O'Brien, Pioneer Project Manager

SPACECRAFT SUBCONTRACTORS

Eagle Picher Joplin, Mo.	Batteries
Texas Instruments, Inc. Dallas, Tex.	Solar Cells
Optical Coating Labs, Inc. Santa Rosa, Calif.	Solar Cell Cover Glasses
Rantec Calabasas, Calif.	Diplexer and Bandpass Filter
Hughes Aircraft Co. Los Angeles, Calif.	Traveling Wave Tubes
Electronic Memories, Inc. Hawthorne, Calif.	Data Storage Unit
Vitro Electronics Silver Spring, Md.	Telemetry Receiver
Solid State Products, Inc. Salem, Mass.	Photo Silicon Control Rectifiers
Western Semiconductors Santa Ana, Calif.	Photo Silicon Control Rectifiers
Sterer Engineering & Manufacturing Los Angeles, Calif.	Pressure Regulator and Relief Valve
Weston Hydraulics Van Nuys, Calif.	Pneumatic Solenoid Valve
Quantitron Los Angeles, Calif.	Coaxial Switch
Philco-Ford Corp. Palo Alto, Calif.	Magnetometer
Marshall Laboratories Torrance, Calif.	Plasma Probe, SCAS Cosmic Ray Instrument, Cosmic Dust Detector
Stanford Research Institute Menlo Park, Calif.	Radio Propagation Detector
Honeywell Radiation Center Lexington, Mass.	Univ. of Minn. Cosmic Ray Instrument

In addition, more than 100 other firms are contributing to the Pioneer Project.

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